Docket No.: WMP-EUP-008

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MAIL STOP: APPEAL BRIEF-PATENTS

By: _____ Date: February 27, 2004

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
Before the Board of Patent Appeals and Interferences

Applic. No.	:	10/056,770 Confirmation No.: 4597
Inventor	:	Gottfried Ferber et al.
Filed	:	January 24, 2002
Title	:	Semiconductor Module and Method for Fabricating the Semiconductor Module
TC/A.U.	:	2818
Examiner	:	Long K. Tran
Customer No.	**:**	**24131**

Hon. Commissioner for Patents
Alexandria, VA 22313-1450

BRIEF ON APPEAL

S i r :

This is an appeal from the final rejection in the Office action dated September 10, 2003, finally rejecting claims 1-3 and 5-11.

Appellants submit this *Brief on Appeal* in triplicate, including payment in the amount of $330.00 to cover the fee for filing the *Brief on Appeal*.

03/03/2004 AWONDAF1 00000101 10056770
01 FC:1402 330.00 OP

Real Party in Interest:

This application is assigned to Eupec GmbH of Warstein, Germany. The assignment will be submitted for recordation upon the termination of this appeal.

Related Appeals and Interferences:

No related appeals or interference proceedings are currently pending which would directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

Status of Claims:

Claims 1-3 and 5-11 are rejected and are under appeal. Claim 4 was cancelled in an amendment filed June 27, 2003.

Status of Amendments:

Claim 1 was amended after the final Office action. *An amendment under 37 CFR § 1.116* was filed on December 15, 2003. Claim 9-10 were cancelled in the amendment filed December 15, 2003. A *Notice of Appeal* was filed on January 16, 2004.

Since the Examiner has stated in the Advisory action dated January 12, 2004 that the amendment filed December 15, 2003 will not be entered, the following discussion will be directed to the claims presented in the amendment filed on June 27, 2003.

Summary of the Invention:

As stated in the first paragraph on page 1 of the specification of the instant application, the invention relates to electrical and electronic appliances, in which the appropriate electronic circuits are usually constructed in modular form, i.e. from individual semiconductor components or groups of semiconductor components which are each disposed on a common substrate and can be prefabricated in order to simplify assembly of the appliance. In the event of damage, it is also easier to exchange modules than individual components or entire circuits.

Appellants explained on page 9 of the specification, line 16, that, in all the figures of the drawing, sub-features and integral parts that correspond to one another bear the same reference symbol in each case. Referring now to the figures of the drawing in detail and first, particularly, to Fig. 1 thereof, there is shown a structure of a semiconductor module with a semiconductor component 1, which is disposed directly on a substrate body 2. The substrate body 2 is configured as a direct copper bonded (DCB) body and contains an insulating ceramic 3 made from Al_2O_3, which on both sides bears a copper layer 4, 5, respectively, which is fixedly joined to the insulating ceramic 3.

Appellants outlined on page 10 of the specification, line 2, that the semiconductor component 1 may be directly adhesively bonded or soldered onto the metal layer 4. According to the invention, a connection conductor 7 is welded to the metal layer 4 by a microlaser in areas 8, 9.

Appellants further outlined on page 10 of the specification, line 7, that, on account of the fixed joining between the metal layers 4, 5 and the insulating ceramic 3, the DCB body is so mechanically stable, and is provided with such a low coefficient of thermal expansion, that the connection conductor 7 can be joined to the metal layer 4 by welding permanently and therefore it is able to withstand fluctuating loads.

It is also stated on page 10 of the specification, line 14, that Figs. 2A and 2B show a more detailed illustration of the way in which the connection conductor 7 is secured and contact is made by laser microwelding.

As set forth in line 18 on page 10 of the specification, Fig. 2A diagrammatically depicts the insulating ceramic 3 and the copper layer 4 in cross section, as well as an end of a connection conductor 7, which at its end facing the substrate

body 2 is bent over in such a manner that its end 10 runs parallel to the surface of the copper layer 4 (see Fig. 2B).

Appellants described in the last paragraph on page 10 of the specification, line 24, that, at the joining edge which is formed between the end 10 of the connection conductor 7 and the copper layer 4, a spot-welded seam 11 is formed, by a plurality of successive spot welds, on one side of the connection conductor 7, and a further spot-welded seam 12 is formed on another side of the connection conductor 7, with the result that the connection conductor 7 is mechanically securely joined, in an electrically reliable manner, to the copper layer 4, with good thermal coupling also being ensured.

Appellants stated on page 11 of the specification, line 8, that the spot-welded seam is produced by a microlaser, as indicated by various positions, which are in each case symbolically indicated by stars, of the microlaser and of the laser beam.

Appellants further stated on page 11 of the specification, line 12, that Figs. 3A-3C show a variant of the invention, in which the welding is carried out from only a single direction with respect to the connection conductor, by a laser 14. Therefore, during an automatic welding operation, the laser 14

can in principle remain at a single location or the work piece, in the form of the semiconductor module, does not have to be moved to a different side of the laser 14, or vice versa. The direction in which the laser 14 is disposed is diagrammatically indicated in Fig. 3A. To produce a multipart, reliable welded joint, it is merely necessary to change the angle of incidence of the laser 14 within tight limits.

It is outlined in the last paragraph on page 11 of the specification, line 25, that, in this connection, it is advantageous if a foot 15 of a connection conductor 13, which is bent off in particular at right angles, has one or more slots 16, 17, at which joined edges form between the foot 15 and a copper layer 18 of a substrate, which edges can be welded by spot-welded seams. The result is a sufficiently long welded seam to create a joint between the foot 15 of the connection conductor 13 and the copper layer 18 that is very good in terms of its mechanical, thermal and electrical properties.

Appellants described on page 12 of the specification, line 9, that the use of the described welding technique can be applied particularly advantageously for DCB substrates, but can conceivably also be applied for AlN substrates or for BeO

substrates, each with a copper coating or a similar metal coating (e.g. aluminium).

It is set forth in the last paragraph of the specification, starting at line 15 on page 12, that finally, it may also be advantageous for the connection conductors 7, 13 and the metal layer 4, 18 of the substrate body 2 to be coated with a metallic or non-metallic coating(s) 20, such as for example nickel, silver, tin, oxides and the like.

References Cited:

U.S. Patent No. 5,629,559 (Miyahara), dated May 13, 1997;

U.S. Patent No. 5,721,044 (Schmidt et al.), dated February 24, 1998;

U.S. Patent No. 6,310,401 B1 (Stoisiek et al.), dated October 30, 2001;

U.S. Patent No. 6,404,065 B1 (Choi), dated June 11, 2002;

U.S. Patent No. 6,521,982 B1 (Crowley et al.), dated February 18, 2003.

Issues:

1. Whether or not claims 1-2, 5, and 8 are obvious over Schmidt et al. in view of Miyahara under 35 U.S.C. §103(a).

2. Whether or not claims 1 and 9 are obvious over Stoisiek et al. in view of Miyahara under 35 U.S.C. §103(a).

3. Whether or not claims 10-11 are obvious over Stoisiek et al. in view of Miyahara and further in view of Crowley et al. under 35 U.S.C. §103(a).

4. Whether or not claims 1-3 and 5-7 are obvious over Choi in view of Miyahara under 35 U.S.C. §103(a).

Grouping of Claims:

Claim 1 is independent. Claims 2-3 and 5-9 depend on claim 1. The patentability of claim 10 is separately argued. Claim 11 is dependent on claim 10. Therefore, claims 2-3 and 5-9 stand or fall with claim 1 but claims 10-11 do not stand or fall with claim 1.

Arguments:

In item 7 on pages 2-4 of the above-mentioned Office action, claims 1-2, 5, and 8 have been rejected as being unpatentable over Schmidt et al. in view of Miyahara under 35 U.S.C. § 103(a).

In item 8 on pages 4-5 of the above-mentioned Office action, claims 1 and 9 have been rejected as being unpatentable over Stoisiek et al. in view of Miyahara under 35 U.S.C. § 103(a).

In item 9 on pages 6-7 of the above-mentioned Office action, claims 10 and 11 have been rejected as being unpatentable over Stoisiek et al. in view of Miyahara and further in view of Crowley et al. under 35 U.S.C. § 103(a).

In item 10 on pages 7-8 of the above-mentioned Office action, claims 1-3 and 5-7 have been rejected as being unpatentable over Choi in view of Miyahara under 35 U.S.C. § 103(a).

Before discussing the prior art in detail, it is believed that a brief review of the invention as claimed, would be helpful.

Claim 1 calls for, inter alia:

> a substrate body having an insulating ceramic layer with a top side, and a metal layer fixedly joined to said top side of said insulating ceramic layer, said substrate body being one of a direct copper bonded (DCB) substrate and an active metallic brazed (AMB) substrate;
>
> at least one connection conductor laser-welded to said metal layer. (Emphasis added.)

As admitted by the Examiner, Schmidt et al., Stoisiek et al., and Choi "fail to teach a connection conductor laser-welded to the metal layer." However, the Examiner has then stated that Miyahara teaches conventional welding, laser welding, and soldering, etc. used in connection with lead frames and that it would have been obvious to one of ordinary skill in the art

at the time the invention was made to use the conventional laser welding method as mentioned by Miyahara for the connection between conductor and metal layer of Schmidt et al., Stoisiek et al., or Choi.

Appellants believe that there is no direct connection between Schmidt et al., Stoisiek et al., or Choi and Miyahara and a person skilled in the art would not have been able to combine the teachings of the references with one another at the time of the invention of the instant application without any motivation to do so.

None of the references shows or suggests direct laser welding on the surface of a DCB or AMB substrate. An important aspect of the invention of the instant application is that until the time of the invention, laser welding directly on the surface of a DCB or AMB substrate was considered impractical because the metallization layer is so thin that it would be melted through by the laser welding. The invention of the instant application ignores this prejudice and teaches the application of laser welding in connection with a DCB or AMB substrate.

Appellants also do not agree with the Examiner's assessment that the limitation "laser-welded" will not establish the patentability of the final product, or in other words that it

is not evident from the product whether the connection was effected through laser welding or conventional welding. Laser welding differs from other welding methods with regard to the welding point size, the missing slagging, and the bead formation. A person skilled in the art can differentiate the laser welding from other welding methods at the final product based on the above-mentioned features.

Therefore, Appellants believe that none of the references, whether taken alone or in any combination, either show or suggest direct laser welding on the surface of a DCB or AMB substrate, as recited in claim 1 of the instant application.

It is accordingly believed to be clear that none of the references, whether taken alone or in any combination, either show or suggest the features of claim 1. Claim 1 is, therefore, believed to be patentable over the art and since all of the dependent claims are ultimately dependent on claim 1, they are believed to be patentable as well.

With regard to claim 10, the slot in the bent foot serves during laser welding, especially at the early stage, to control the laser light and thus to moderate the beginning energy of the laser so that the energy guided in the substrate rises with a flat slope. Otherwise, the energy would rise

suddenly when the laser is turned on, which means that the energy would rise with a very steep slope and thus lead to a "blowing out" of the metallization. The reason therefor is the low beginning absorption of copper, which rises dramatically and erratically with the formation of the welding fused metal. There is a danger of melting through of the thin metallization and damaging of the ceramic layer under the thin metallization having a high absorption degree. Damage to the insulation ceramic accounts for more than 90% of the insulation failure, namely a break down of the module during manufacture. A further rise of the laser energy is necessary due to the application of certain copper alloys so that the danger to the ceramic layer increases even further. Due to the dispersion of the laser light through the slot as shown in Fig. 3, the rise can be slowed down and thus the laser can be shut off in time before reaching the critical energy.

The apertures 144 formed in the flange portion 134 of the strap 112 as shown in Figs. 5-6 of Crowley et al. are filled with adhesives or solder in order to form mechanically interlocking "keys" 146 (see column 6, lines 16-21). Clearly, the apertures 144 according to Crowley et al. do not and cannot serve, during laser welding, for the control of the laser light and thus to moderate the beginning energy of the

laser so that the energy guided in the substrate rises with a flat slope.

In view of the forgoing, the honorable Board is therefore respectfully urged to reverse the final rejection of the Primary Examiner.

Respectfully submitted,

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For Appellants

YC/bb

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Appendix - Appealed Claims:

1. A semiconductor module, comprising:

a substrate body having an insulating ceramic layer with a top side, and a metal layer fixedly joined to said top side of said insulating ceramic layer, said substrate body being one of a direct copper bonded (DCB) substrate and an active metallic brazed (AMB) substrate;

at least one connection conductor laser-welded to said metal layer; and

at least one semiconductor component disposed directly on said substrate body facing said metal layer.

2. The semiconductor module according to claim 1, wherein said insulating ceramic layer of said substrate body is formed of Al_2O_3.

3. The semiconductor module according to claim 1, wherein said metal layer is formed of at least one material selected from the group consisting of copper and aluminium.

5. The semiconductor module according to claim 1, wherein said insulating ceramic layer contains AlN.

6. The semiconductor module according to claim 1, wherein said insulating ceramic layer contains BeO.

7. The semiconductor module according to claim 1, wherein said connection conductor is one of a plurality of connection conductors each formed of a at least one material selected from the group consisting of Cu, Al, CuSn and CnZn.

8. The semiconductor module according to claim 1, including a coating disposed on said metal layer.

9. The semiconductor module according to claim 1, wherein said connection conductor has a foot which is bent at right angles.

10. The semiconductor module according to claim 9, wherein said foot has at least one slot formed therein.

11. The semiconductor module according to claim 10, wherein said slot has a given width that is approximately equal to a thickness of said foot.